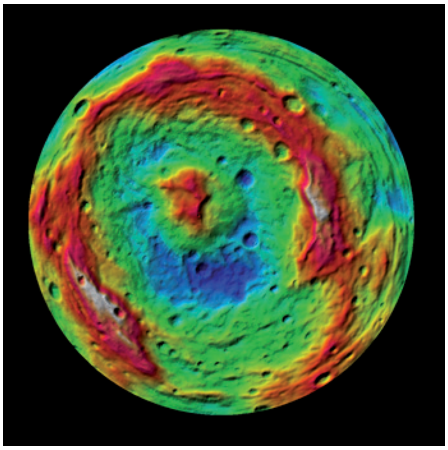
PLANETARY SCIENCE

Vesta's veneer

Icarus **221,** 544–559 (2012)



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NASA's Dawn spacecraft has observed terrains rich in dark material on the surface of Vesta. Spectral data suggest that these terrains share a similar composition with the class of meteorites known as carbonaceous chondrites, suggesting that the dark material could have been delivered by meteorite impacts.

Vishnu Reddy at the Max Plank Institute for Solar System Research, Germany, and colleagues analysed Dawn images to characterize the properties of the low-albedo dark material. They find that the majority of dark terrains are composed of similar materials, and that dark material is particularly abundant around the rim of the ancient south polar crater Veneneia. This is consistent with an origin of the dark material from impacts rather than volcanism. They suggest that Veneneia is the product of a collision with a carbonaceous chondrite, which deposited a mixture of dark material and surface rocks as ejecta around the resulting crater. Smaller impacts of carbon-rich asteroids could explain the distribution of dark material elsewhere on Vesta's surface.

Intriguingly, the similarities between the dark material and carbonaceous clasts in howardite meteorites found on Earth are further evidence that these meteorites originally hailed from Vesta. *TG*

MARINE CHEMISTRY

Oceanic oxygen loss

J. Geophys. Res. http://doi.org/jjg (2012)

Oceanic oxygen levels are highly sensitive to climate variability and change. An extensive analysis of hydrographic data suggests that dissolved oxygen levels have fallen in the upper North Atlantic Ocean over the past five decades.

Ilaria Stendardo and Nicolas Gruber of ETH Zurich, Switzerland, use data from over 300 cruises to show that oxygen levels fell in upper ocean layers across much of the North Atlantic between 1960 and 2009. They suggest that changes in ocean circulation and ventilation were largely responsible this decline — which amounted to 57 Tmol of oxygen over the 50-year period. Conversely, dissolved oxygen concentrations rose in deeper water layers by an equivalent amount. An increase in the solubility of oxygen — due to the long-term cooling of these deeper waters — appears to be responsible for this rise in oxygen.

However, the researchers suggest that future warming could reduce oxygen solubility and strengthen ocean stratification, which would lead to oxygen loss throughout the entire North Atlantic. *AA*

DEEP EARTH

Anomalous mantle

Earth Planet. Sci. Lett. **353–354,** 253–269 (2012)

The slowing of seismic waves as they pass through parts of Earth's deep mantle beneath the Pacific Ocean and African continent has been attributed to the existence of hot and chemically distinct piles of ancient mantle. Numerical modelling combined with thermodynamic calculations suggest that temperature contrasts alone can explain this seismic deceleration.

To analyse the nature of the mantle anomalies that cause passing seismic waves to decelerate, Rhodri Davies at Imperial College London, UK, and colleagues used a numerical model to simulate the accumulation of distinct piles of mantle over hundreds of millions of years as a result of mantle circulation and plate tectonic motions. Their model simulated the formation of piles that are both warmer and chemically distinct from the surrounding mantle or piles that differ only in temperature. Comparing thermodynamic calculations of seismic wave velocities in the simulated piles with observed wave speeds, they found that temperature variations alone can explain the slow velocities, and chemical variations are not required.

The researchers suggest that although considerable chemical heterogeneity must exist in Earth's mantle, its significance for mantle dynamics could be far less than previously thought. *AW*

PALAEOCLIMATE

Sun and wind

Geophys. Res. Lett. http://doi.org/jjf (2012)

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An equatorward shift of the belt of westerly winds at southern mid-latitudes occurred during the prolonged solar minimum between AD 1645 and 1715, according to an analysis of model simulations and palaeoclimate records.

Vidya Varma of MARUM, University of Bremen, Germany, and colleagues used two transient climate model simulations to assess the effects of the Maunder Solar Minimum on atmospheric circulation, as well as calculating the effect of the reduced solar output on stratospheric ozone content. In the simulations, the solar minimum was associated with a weakening of the wind belt between 40° and 60° S, and a strengthening of winds to the north, linked to oceanographic changes. However, the equatorward shift was strongest in the simulation that included a reduction in stratospheric ozone concentrations, as would be expected from a reduced photolytic production of ozone in the upper atmosphere during solar minima.

A reconstruction of westerly wind intensity over the past millennium from marine sediments also supports a northward shift of the wind belt during prolonged periods of low solar output. The researchers attribute the shift to a combination of stratospheric changes and ocean and sea-ice dynamics. *AN*

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